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RAPTOR RESEARCH

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FALCO KREYENBORGI—A CURRENT REVIEW

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Falco kreyenborgi is perhaps the rarest and certainly the least known of the ten or so "great" falcons (Johnson 1972). It inhabits the Patagonian region of South America and is currently recognized from only five collected specimens (Hickey 1969) and several sight records. The general ecology of the species is unknown (Olrog 1968) and its nest and breeding behavior remain undescribed with two exceptions; a few fragmentary comments on the original nest and the alleged finding of a pair with one recently fledged young by Carlos Kovaks in Chubut, Argentina in 1975 (W.G. Vasina in letter to C.M. White, 1981). The following summarizes the information presently available on *Falco kreyenborgi*.

Specimens and Photographs (see Table 1)

The first specimen of *kreyenborgi*, a recently fledged male, was captured at its eyrie in southern Chile in 1925 (Dementiev 1965). The exact location of the site was kept secret, but was allegedly located in the vicinity of Punta Arenas, Chile. The circumstances surrounding the event are unclear. Stresemann and Amadon (1963) wrote:

"Professor C. C. Olrog, Instituto Lillo, Tucumán, Argentina, tells us that he met certain otter hunters who said they had personally taken the falcons from an eyrie on a small rocky island south of Tierra Del Fuego . . ."

However, in a letter written to Anderson (6 January 1979) Olrog amended this as follows:

"The people I inquired did not say where the birds came from; besides I had the feeling they did not want to tell, and talking to the cook on board, I got the impression that the chicks did not at all come from 'some small island' but from Seno Skyring [northwest of Punta Arenas] where at that time there was a coal mine . . . It seems likely that the locality was invented."

Kleinschmidt (1937) was told that the nest was inaccessible at times because of heavy snows and that it was on a "hillside cliff."

The original falcon was sold to M. Carlos Strauss, a German living in Punta Arenas

who acquired and sold animals to zoos in Europe. While still in immature plumage, the falcon was transported to the Zoological Garden in Münster, Germany. It died in October 1932 and became the type specimen of *Falco kreyenborgi* (Dementiev 1965).

Stresemann and Amadon (1963) imply that the three falcons were taken from the same eyrie at one time. However, Dementiev (1965) reported:

"At a later date, sadly unknown, two other eyass falcons [a male and a female] had been captured from the same nest as the previous bird . . . They also arrived at the zoological garden at Münster, attained an adult stage and died" (translation).

The time-lag accounts for the type specimen being placed in a different museum (Bonn, Germany) than the other two (Münster, Germany). It is not known how long an interval separated the arrival of these birds in Münster, it may have been months or years, although each of the birds attained adult plumage before death. Kleinschmidt (1937) noted that all three falcons were sent to Germany by Strauss.

Sometime between 1925 and 1929 a German falconer, Herr-Doctor Kreyenborg, brought the original specimen to the attention of Dr. Otto Kleinschmidt, who examined it while still alive at the Münster zoo. Kleinschmidt recognized it as a new species and named it in honor of Dr. Kreyenborg (Kleinschmidt 1929, 1937).

In 1937, in his second article, Kleinschmidt described an unsuccessful breeding attempt involving *Falco kreyenborgi*. Dementiev (1965) summarized the results:

"Kleinschmidt (1937) has published the fact that the male *kreyenborgi* in the Münster zoo was paired with a female of *Falco peregrinus cassini* which laid an egg. The details remain unfortunately unknown . . ." (translation).

Kleinschmidt (1937) noted that the male "sat on the eggs while the female . . . was sickly" (translation). This is one of the first recorded instances of falcons attempting to breed in captivity. A photograph of the type specimen of *Falco kreyenborgi* was also published in the 1937 article.

Later, Kleinschmidt (1939) referred to the new species as *Falco peregrinus kreyenborgi*. This change in systematics reflects Kleinschmidt's well known penchant for linking various related forms into "Artenkreise." He also included a color plate of *kreyenborgi* consisting of a ventral photograph of a dead adult with outstretched wings. It was presumably one of the Münster zoo falcons.

Nothing more was learned about the species until 7 April 1940, when Olrog (1948) collected a fourth specimen, an immature male, at Estancia Viamonte on the Argentine side of Isla Grande. Prior to this, it was speculated that the Münster falcons might have been an aberrant family group (Kleinschmidt 1937) or originated from a different location than South America. Kleinschmidt (1929) himself had originally thought that they might have come from Africa. Therefore, the collection of another specimen by Olrog from the same general location as the original birds was significant (Stresemann and Amadon 1963). Olrog (1948) included dorsal and ventral photographs of the bird after preparation as a museum skin.

The next reference to *kreyenborgi* was again provided by Kleinschmidt (1958). In the revised third edition of a book on the hawks and owls of Germany, he included a color plate of paintings showing 22 geographical representatives from the Peregrine Falcon species group. Among the illustrated examples is an adult *kreyenborgi*.

On 15 August 1961, Károly Kovaks collected the fifth specimen of *kreyenborgi* in an agricultural area approximately 5 km north of El Bolson, Rio Negro province, Argentina (Kovaks 1962-3). A publication included front and rear photos of the mounted specimen. This record extended the range of the species considerably even though it was an immature bird (Brown and Amadon 1968). Zsolt Kovaks allegedly found a sixth specimen in Chubut province during the mid-1970s but it was too decomposed to be prepared (Csaba Kovaks-pers. comm.). At present, we know nothing more of this particular bird.

The color plate of adult and immature *kreyenborgi* in Brown and Amadon (1968) was based on the El Bolson specimen and one of the original adults, both borrowed by Amadon (pers. comm.). Another photograph of the head of the El Bolson falcon was included in a paper on Argentine Peregrines (Vasina 1975).

Until recently, there were no known photographs of a live specimen of *kreyenborgi*. On 10 March 1979, Ellis and Glinski (1980) took the first known photos of a wild bird (immature) on Isla Grande. In December 1979, T. Roundy took motion pictures of another *kreyenborgi* (age unknown) both perching and in flight. This film is currently in his possession (pers. comm.).

Sightings

The rarity of the species is demonstrated by the failure of several expeditions to even sight the bird. However, P. W. Reynolds stated that "passage birds" were seen quite frequently at Viamonte during the austral winter (Olrog 1948) and recorded seven sightings over one season while during the same period he had 20 Peregrine sightings (W. G. Vasina, lett. to C. M. White, 1981). All other recorded sightings of *kreyenborgi* are summarized below in chronological order.

1. 3 May 1975. M. Rumboll (Jehl and Rumboll 1976) sighted a single *kreyenborgi* "4 km north of Misión, near Rio Grande, Isla Grande" feeding on a large unidentified passerine "presumably *Pezites militaris*" (Military Starling). This is the first recorded prey item for *kreyenborgi*.

2. 11 May 1975. Rumboll (Jehl and Rumboll 1976) sighted another at "Estancia Condor, just north of the Straits of Magellan, and 200 km north of Misión." He adds that the two sightings may have been of the same bird.

3. 10 March 1979. Ellis and R. Glinski (1980) observed an adult (probable female based on size) perched for two min. at a distance of 40 m and later seen flying on the northeastern coast of Isla Grande. It had a small passerine prey item (size class ca. 30 g).

4. 10 March 1979. Ellis and Glinski (1980) saw a juvenile (probably female based on size) as close as 12 m while it perched and fed on the carcass of a large gull (probable *Larus* sp.) about 30 km from the earlier sighting. This is the third recorded prey item for *kreyenborgi* and suggests that the falcon subsists primarily on birds.

5. 12 March 1979. Glinski (Ellis and Glinski 1980) sighted a falcon (probable female based on size) for 1-2 min. along the Atlantic coast less than 1 km from the 10 March adult sighting, likely the same bird.

6. 20 December 1979. T. Roundy observed a falcon for approximately 30 min. perched and flying over steppe habitat in the central region of Argentine Patagonia (pers. comm.).

Two additional 1980 sightings are described in another paper by the authors (Ellis and Anderson, *this issue*).

Taxonomy

At present, *Falco kreyenborgi* is considered to be a separate species. However, during the 55 years since the bird was first discovered, several opinions about its taxonomic position have been advanced. In the most complete review of the problem, Stresemann and Amadon (1963) support Kleinschmidt's original contention that *kreyenborgi* is indeed a separate species.

The main taxonomic confusion concerns the position of *kreyenborgi* within the genus *Falco* and its relationship to *Falco peregrinus*. Some authors (c.f. Peters 1931:290) considered the bird to be a questionable subspecies of the Peregrine, while Kovaks (1962-3) regarded it as most closely allied to the Gyrfalcon (*Falco rusticolus*) and Dementiev (1965) suggested that it was possibly a race of the desert falcon complex, *Falco pelegrinoides*. In fact, Kleinschmidt (1929) originally mistook the first specimen of *kreyenborgi* for a Barbary Falcon (*Falco pelegrinoides*). Stresemann and Amadon (1963) and Brown and Amadon (1968) also noted the similarity. The former authors consider that the absence of the typical adult Peregrine plumage ("color and pattern") probably removes *kreyenborgi* from *Falco peregrinus* and yet its basic morphology suggests that it belongs in the Peregrine group.

Since a Peregrine (*Falco peregrinus cassini*) inhabits the same general area as *kreyenborgi*, it is tempting to suggest that *kreyenborgi* might prove to be a member of the Saker-Gyrfalcon (*Falco cherrug-Falco rusticolus*) group, of which the nearest New World representative is the Prairie Falcon (*Falco mexicanus*). Minute examination of

Table 1. Specimen Data for *Falco kreyenborgi*

Characterization	Age/Sex	Date Collected	Locality	Collector	Present Location
Type Specimen	Adult Male	1925	Near Punta Arenas, Chile	Unknown	Alexander Koenig Museum, Bonn, Germany
"Münster" Specimen 1	Adult Male	192?	Near Punta Arenas, Chile	Unknown	As of January 1979, both were at the Museum für Naturkunde, Berlin, Germany.
"Münster" Specimen 2	Adult Female	192?	Near Punta Arenas, Chile	Unknown	Prof. L. Franzisket was arranging for their return to Münster (Westf. Landesmuseum für Naturkunde)
Viamonte Specimen	Immature Male	7 Apr 1940	Estancia Viamonte, C. C. Olrog Isla Grande, Argen.		Royal Museum of Natural History (Riks Museum), Stockholm, Sweden
El Bolson Specimen	Immature Male	15 Aug 1961	El Bolson, Rio Negro, Argentina	Karoly Kovaks	Puerto Madryn, Chubut, Argentina*

*Reported to be in the possession of Carlos Kovaks, 1980.

four of the specimens by Stresemann and Amadon (1963) showed however that *kreyenborgi* belongs to the Peregrine group as demonstrated by the wing formula, wing shape, and the great length of the outer toe. Even more remarkably, it seems inseparable in size from *cassini* as judged admittedly from very few specimens of either species. Brown and Amadon (1968) conclude "it is impossible to be sure what this form is until more is known of it."

Common Name

"Kleinschmidt's Falcon" was first suggested as a common name for *Falco kreyenborgi* by Stresemann and Amadon (1963). It was subsequently used by Dementiev (1965), Johnson (1965), Brown and Amadon (1968), Walker, et al (1973), and Blake (1977). Grossman and Hamlet (1964) first used the names "Pallid or Tierra Del Fuego Falcon" followed by Humphrey, et al (1970), Jehl and Rumboll (1976), Gochfeld (1977), and Clements (1978).

In pursuit of uniformity in referring to this falcon, we suggest that the terms "Tierra Del Fuego Falcon" and "Kleinschmidt's Falcon" be suppressed since Kleinschmidt's contribution is cited in the full scientific name, *Falco kreyenborgi* Kleinschmidt, and to date not all of the specimens and sightings are from Tierra Del Fuego. Future research will show if the descriptive term "Pallid Falcon" or the less restrictive, locative term "Patagonian Falcon" best suits this elusive bird.

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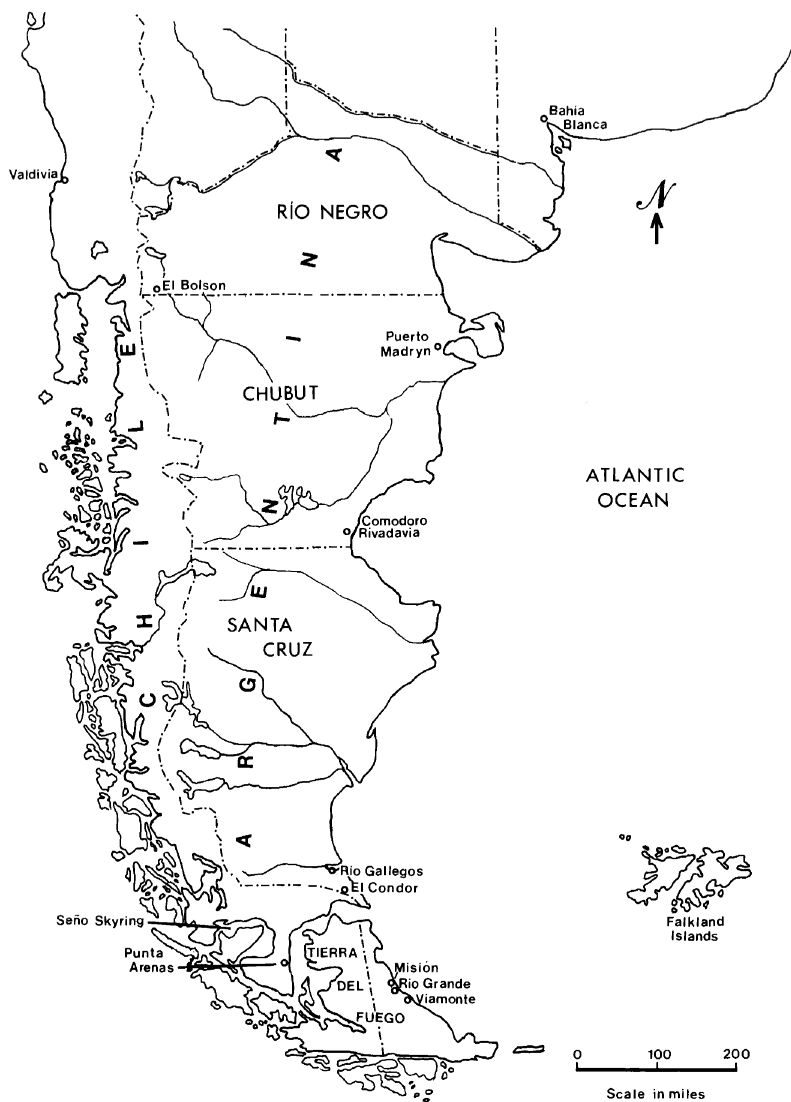
ANNOUNCEMENT

QUEBEC RED-SHOULDERED STUDY

In the spring of 1980, the Macdonald Raptor Research Centre of McGill University initiated a Red-shouldered Hawk banding and marking project in the south-western region of Quebec to determine dispersion, migratory movements and recruitment.

Birds are being banded with red, white, blue and yellow (and combinations thereof) plastic bands and standard FWS bands. We would appreciate any sightings of these birds. Observers are asked to note the band colours and their relative positions on the legs, as well as the location of the sighting.

Please report this information along with your name, address and phone number to the Bird Banding Laboratory, Laurel, MD 20811 with a copy to BRENDA PENAK AND DAVID BIRD, Macdonald Raptor Research Centre, Macdonald Campus of McGill University, Ste. Anne de Bellevue, Quebec H9X 1C0



FALCO KREYENBORGI: MORE PIECES FOR THE PUZZLE

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Information on the status and taxonomic position of *Falco kreyenborgi* is reviewed in a companion paper (Anderson and Ellis, *this issue*). Observations made December 1980 may help clarify the taxonomic position of the bird.

In quest of information on *kreyenborgi*, we visited southern Chile and Argentina from 28 November until 20 December 1980. Working under the hypothesis that if *kreyenborgi* does exist as a distinct and viable species, it must have a population center where it can be encountered in significant numbers, we searched what we considered to be the most likely breeding zone, the Patagonian steppe from Rio Negro to Santa Cruz Provinces of southern Argentina. We located nine previously unknown pairs of Peregrine Falcon (*Falco peregrinus cassini*) and visited two Peregrine sites found in 1979. We found two examples of *kreyenborgi*.

The first observation began about 1800 on 11 December when Roundy noted two unidentified falcons soaring together near a river cliff (ca. 80m high) where an adult (probably female) Peregrine was later observed perched in a pothole. As Roundy approached, a Peregrine protested and soared overhead, then drifted off. Roundy found the rock cavity devoid of eggs or young and the Peregrine failed to reappear. As Roundy left the area, he noted a large white falcon perched near the center of the cliff. It showed plumage characteristic of an adult *Falco kreyenborgi* (as illustrated in Plate 162, Brown and Amadon 1968). After observing it for ca. 45 min., Roundy left while the bird remained perched on the cliff.

During this same period Anderson located a pair of adult Peregrines (apparently non-productive) on a nearby tributary of the river and near enough that the females seen at each site may have been the same bird.

On December 12, we returned to search for a breeding site of the white falcon. One or more of us watched the cliff from 1200 to 2100. We also searched river cliffs and side canyons near the cliff. During the day we made the following observations of large falcons in the area. At about 1400 Ellis observed an adult (probably female) Peregrine

about 1.5 km east of the river. The bird perched ca. 10 min. on a rocky knob along the ridge crest, then continued toward the cliff. At about the same time Roundy saw an adult (probably female) Peregrine (likely the same bird) fly in from the back side of the cliff and perch near the rim for 10–15 min. while being harassed by a stooping American Kestrel (*Falco spawerius*). During its stay, the Peregrine performed a series of *Eechip* calls before leaving with the kestrel still in pursuit.

At ca. 1643 a white falcon was again detected perched high on the cliff. It remained until 2053 when it flew away from the river at dusk. During its stay, we photographed it and carefully observed plumage and behavior from distances of 60 to 100 m using 7x and 10x binoculars.

Fine details of the bird's plumage could have escaped detection but in general the falcon was white below except for black primary tips (readily visible in flight) and a series of broad dark bands (10–15) crossing the tail. A wedge of light gray was noted on the right side of the breast, but since this patch was not symmetrically matched on the left side, it may have been soilage. Above, the secondaries were coarsely checked white and dark gray-black. The back and lesser wing coverts were finely checked with white and dark gray with a hint of brown. The primaries appeared dark above, and when folded nearly reached the tip of the tail. In general the head was white, conspicuously marked with dark narrow malar and eye stripes. Less conspicuous dark marks were noted on the crown (darkest posteriorly) and nape where lateral ocelli and a weak central stripe were noted. The cere, orbits, and feet were bright yellow to orange. The eye was dark. Because of the bird's relative small size, quick movements, and general morphology, we judged it a male.

The white falcon also exhibited behavior demonstrating its close association with the cliff. During the evening it retrieved and consumed an unidentified small bird cached on the cliff. During an earlier 10–15 min. period, it gave several series of rasping calls while exploring a broad sloping ledge. These notes closely resembled the *Eechip* call associated with falcon reproductive displays described by Wredge and Cade (1977).

Over two days we observed two large falcons attending the same cliff. They individually exhibited behavior associated with a reproductive attempt although no interactions were observed involving the white falcon. One was an adult (probably female) Peregrine: the second was judged to be a male *kreyenborgi*. The significance of these observations is best judged in context of our observations made at another site three days later.

On 14 December we revisited a Peregrine breeding site where Roundy observed a pair with fledged young in December 1979. After searching the area, we located a pair of adult Peregrines on 15 December with four recently fledged young (1–2 weeks out of the nest). The darkest juvenile was a deep slate above with a dark cap and a medium rufous ventral background color. The second and third birds were lighter above and below but were still definitely Peregrine falcons. The fourth if seen alone would have unquestionably been identified as *kreyenborgi*.

The family group was observed through the day (1100–2200). During this period, adult Peregrines brought food to the young three times, but never directly to the light one. Twice the light falcon "pirated" prey from the nestlings and once an adult took the prey back from the light bird. The light falcon was observed interacting as a normal fledgling within the family group and at dusk three of the young, including the light bird, roosted in close proximity on a cliff wall.

To document as accurately as possible the light bird's plumage, we captured and photographed it. The accompanying frontispiece illustrates that the bird was marked much like the immature *kreyenborgi* collected in 1961 (Kovacs 1962-3) and the immature photographed on Isla Grande in 1979 (Ellis and Glinski 1980). The light bird (a probable female) weighed 1010 ± 10 gms compared to 995 ± 10 gms for its supposed female nest mate. Wing and tail measurements were not taken because the remiges and rectrices were not fully developed. The light bird was released at the breeding site on 16 December.

Because the young falcons had fledged prior to our visit, we cannot be certain that the light falcon was produced by the Peregrines. The bird was so different from even the palest of the other fledglings that there is reason to suspect that it may have been produced elsewhere. However, the stage in primary and tail development agree well with the other young at the site and the bird was treated as a member of the family group.

The present evidence suggests that *Falco kreyenborgi* does not exist as a separate species and that white falcons occasionally observed on the plains of Patagonia could be characterized as the pallid form of the Austral Peregrine. However, there is reason for doubt. First, the Peregrine, although morphologically highly variable worldwide (Vaurie 1961), is nowhere known to produce a light (or dark) color phase. (However, the range of morphological color expression of immature *F. p. pealei* nearly covers that shown by the dark and "white" bird mentioned here but do not occur in such discrete phases [C. M. White pers. comm.].) Second, however unlikely, it may be that the white juvenile falcon which we observed had wandered in from a nearby eyrie where it had white parents. An example of natural, temporary, cross-fostering of a fledgling Prairie Falcon (*Falco mexicanus*) on Peregrine Falcon (*F. p. anatum*) foster parents has been documented (Ellis and Groat ms.). Conversely, the pale juvenile may not be truly representative of *kreyenborgi*: its light buffy background color is darker than that reported for the two juveniles for which we have descriptive information (Kovacs 1962-3, Ellis and Glinski 1980). The bird, however, was in fresh plumage which with reasonable sun bleaching may yield a near white ventral background color. The general pattern of the feather barring and streaking agrees well with the two juveniles mentioned above and with the specimen from Viamonte, Isla Grande (Olrog 1948).

A final point of confusion stems from our incomplete knowledge of the origin of the first three specimens of *kreyenborgi* (Anderson and Ellis, *this issue*). It may be that all members of the family were white birds, or just as likely, the laymen who took the young may have preferentially selected the unusual white birds and made no mention of typical Peregrine siblings or parents.

In summary, while the most likely explanation of the available evidence is that *Falco kreyenborgi* is a pale color phase of the Peregrine (*F. p. cassini*), there are still enough unanswered questions to leave room for doubt and to fuel future research. Why does the white form occur only in southern Patagonia? What genetic mechanism controls expression of the white form? What is the ratio of light to dark birds? Do light and dark birds ecologically segregate? The mystery surrounding the white falcon remains.

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NOTES ON OBSERVING NESTING ACCIPITERS

by

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Since 1976 we have been observing European Sparrowhawk *Accipiter nisus* nests during the breeding season to determine this predator's effect on the population of titmice *Parus* spp. in Wytham Woods, Oxford. While results of this study have been published elsewhere (Geer 1978, Perrins and Geer 1980, Geer in press), we present here some methods for watching hawk nests since we have had good results observing from close quarters, a technique that many researchers of raptors have expressed to us a reluctance to use.

Between 1976 and 1979 we placed 8 blinds at distances of less than 6m from Sparrowhawk nests during the incubation and nestling periods. Our first attempt entitled placing a canvas blind on top of a platform of wood and angle-iron built in the fork of a tree adjacent to the tree holding the hawk nest. Building took 5 one-hour periods, spread out over 4 days to minimize disturbance, and was begun 2 days after the young hatched. Once completed and occupied, the adults showed no shyness of it. We found that the 6m distance from blind to nest was too great to be able to identify prey accu-

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ately even from photographs taken with a 35mm SLR camera with a 300mm lens. To improve on these observations, we placed blinds even closer to the nests since Newton (1978) had success putting blinds as close as 2m from Sparrowhawk nests. Because trees suitable for placement of blinds were seldom available close enough to hawk nests, the remainder of our blinds were put on freestanding towers of tubular metal scaffolding constructed alongside nesting trees. Towers were erected in short work periods over a series of days to reduce disturbance of the parents; a total of about 4 hours was usually required. Wooden planks were lashed to horizontal scaffolding poles to form a platform on which sat a hardboard blind, lashed to the platform for security (Figure 1). In all instances but one, construction was begun after eggs hatched. In the single case, construction started about 1 week before the eggs were due to hatch. Here the female continued to incubate while building was underway below her. When work reached the nest level she flew off only to return less than 10 minutes later and continued incubating while watching us work less than 2m from the nest. Towers built to the level of the nest ranged from 11 to 17m in height and blinds either abutted the nest or were up to 2.5m from the center of the nest. Blinds were first occupied at completion of building and adults returned to feed and brood the young within 15 minutes; exhibiting little or no shyness of the structures. Observations were made for approximately 16 hours/day and identification of prey species was easy with unaided eye or with a 35mm SLR camera with a 135mm lens. To avoid premature fledging of young use of the blinds was discontinued 4 days prior to the time the young were due to fledge.

Three other techniques used, 2 successful and 1 unsuccessful, further illustrate the tolerance of accipiters to human activity during the nesting season. First, at one nest the eggs failed to hatch. Foster young were introduced and readily accepted by the parents. Because the tree containing this nest was growing off the perpendicular on soft sloping ground a tower could not be safely built to the height of the nest, 18m up. Therefore, we lowered the nest and young to a level where it could be safely observed. First a tower 6.5m high was built alongside the nest tree. Then the nest and young were lowered to a platform of wood and angle-iron (Figure 2) lashed to the tree about 4m below its original position and left for the night to see how the young fared. The following day they had been fed and were in good condition; they were then lowered the rest of the distance to the tower and blind in the next 2 days, a total of 12m in 3 days. When watches began the parents were somewhat nervous with the arrangement, but they continued to feed the young until and after they fledged.

Second, at one nest we used a long pair of tongs pushed through a hole in the front of the blind to remove tits brought to the nest in order to recover metal bands from the corpses; these prey items were returned after removal of the band. At first the parents flew off when the tongs were extended, but soon they became so accustomed to the procedure that tugs-of-war developed over prey items we tried to remove.

Third, a nest containing small young was moved from the original nest tree to an adjacent tree where construction of a tower would have been easier. Here the female remained in the area but would not come to the nest in its new location. Therefore, the nest was returned to its original position after a few hours; as soon as this was done the female returned to the nest and brooded and fed the young in a normal manner.

The foregoing show that not all accipiters are intolerant of blinds close to the nest or manipulation of their breeding habits. The methods we describe may not prove successful in all attempts, but they provided substantially improved results for us.

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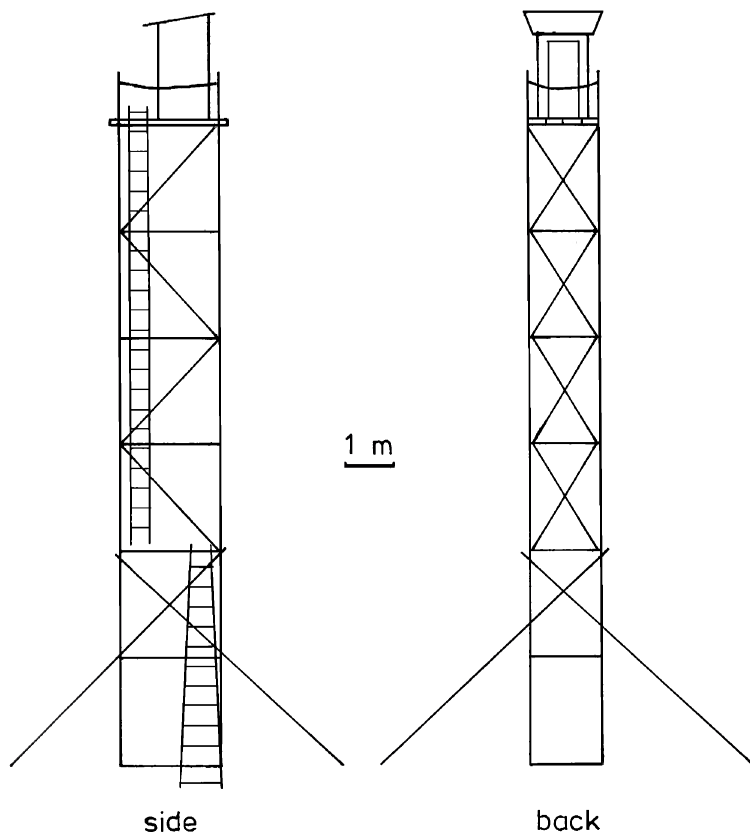


Figure 1. Diagram of a scaffolding tower with a hardboard blind.

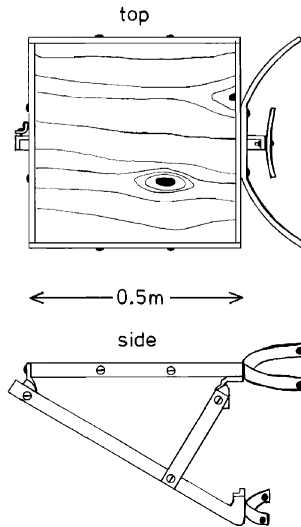


Figure 2. Diagram of nest platform used for lowering of nest.

HABITUATION TO HUMAN DISTURBANCE IN NESTING ACCIPITERS

by

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Abstract

Data are presented on habituation to human activity by 2 accipiters, the Goshawk (*Accipiter gentilis*) and the Cooper's Hawk (*A. cooperii*). Human activities near nests include snowmobile traffic, cross-country and alpine skiing, hiking, horseback riding, and the construction of homes. Two possible explanations for apparent "tameness" in these birds are as follows: 1) The hawks tolerating heavy use of nesting areas by people were younger, less experienced birds, and 2) The nest areas are traditional for Goshawks and Cooper's Hawks, providing secure nest trees and plentiful prey.

Introduction

Effects of disturbance at nest sites have been documented for many raptor species (Fyfe and Olendorff 1976, Hennessy 1978). Stalmaster (1978) discussed responses of the Bald Eagle (*Haliaeetus leucocephalus*) to human activity on eagle wintering grounds. Information is available about the effects of disturbance on raptor behavior, but little in-

formation is available on behavioral adaptations and habituation to humans. Accipiters, particularly Goshawks, are described as sensitive to human activity and would be expected to be sensitized to human activity at the nest (Hennessy 1978).

Study Area and Methods

The 800 ha study area is located 24 km north of Provo, Utah. Elevation ranges from 1991–2195 m. Approximately 80 percent of the area is forested, predominately aspen (*Populus tremuloides*) with some mixed stands including white fir (*Abies concolor*) and Rocky Mountain douglas fir (*Pseudotsuga menziesii*). A ski resort covers about 390 ha and the rest of the area is used for cross-country skiing and snowmobiling during the winter months. Extensive use of the area occurs during the summer by horseback riders, hikers and motorcyclists.

Three nests in "disturbed" areas were observed in 1979—2 Goshawk and 1 Cooper's Hawk, and 2 Goshawk nests in 1980. Data on breeding behavior were collected from 6 March–1 August, 1979, and 6 February–20 July, 1980. Observations were made from ridges up to 0.8 km from nests early in the season. Blinds were constructed at all Goshawk nests. Weekly visits were made to the Cooper's nest. Productivity and responses to various forms of human activity were recorded.

The nests will be discussed as follows. One Goshawk nest (Mandan) was located on the ski resort, 32 m from a ski run in 1979 and 31 m away in 1980. The second Goshawk nest, about 1100 m northwest of the first is referred to as the Meadows nest. The Cooper's Hawk nest was 914 m northwest of the Meadows Goshawk nest.

Results

Mandan Nest

Goshawks were first seen at Mandan (Fig. 1) on 9 March, 1979 and 25 February, 1980. In 1979 a bird was calling (similar to begging of young Goshawks) in an area about 213 m southwest of where the Mandan pair eventually nested. For a description of Goshawk vocalizations, see Schnell (1958). Although the bird was not visible from the ski trail, it is likely that it could see the skiers, because the hawk was located between two trails. A minimum of nine skiers per min. passed as the bird vocalized.

Additional "disturbance" at this site was the construction of a house 91 m from the nest in 1979 and 205 m away in 1980. Building began before the Goshawks were seen in the area. Activity near the nest included noise associated with construction, cutting of trees, and the presence of 3 or more persons for a minimum of 8 hours daily. Cement trucks passed within 31 m of the 1980 nest 2 or more times daily. As the snow melted, hikers and horseback riders rather than skiers passed within 35 m of both nests.

A blind was built 16 m from the nest on 8–14 June, 1979 and 21 m away in early April, 1980. Disturbance associated with construction of the blind was limited to one half hour per day, every 2–3 days in 1979. Young Goshawks were about a week old at this time. The female watched the building operations of the house and blind apparently without altering her brooding position. The first attack on a human by the female came when a tree 1 m from the nest was climbed to cut branches that obscured the view from the blind. In this instance she stood on the edge of the nest, on one foot, until the climber was level with the lower edge of the nest before she flew at him. After this initial attack the female left the nest and flew at me, vocalizing, each time I entered the woodlot. The male usually flew toward the nest and made passes from a distance of 15

m or more. When I climbed to the blind I was struck solidly on the back, head, or arms by the female. Aggressive behavior ceased within a half hour of entering the blind.

The 1980 blind was installed prior to egg laying. Adults were not present during construction, and the blind was finished in 2 days. The new nest was further from the unfinished house, and closer to the ski trail or road. The behavior of the adults was unchanged from 1979.

Meadows Nest

Goshawks were first seen in the vicinity (Fig. 2) on 6 March 1979 and 6 February 1980. While cross-country skiing in 1979 a Goshawk flew directly in front of me, cackling, then landed approximately 9 m above me in a conifer. The bird stood on one foot as I passed underneath.

The nest used in 1978 was in a more secluded part of the woods, but by 21 March 1979, it was evident that this pair of Goshawks had chosen an alternate nest for use in 1979. This nest was over a dirt road used extensively for recreation.

During March-May snowmobiles passed the nest a minimum of 2 times per day, 3 days a week. The responses of the Goshawks varied. On 31 March 1979, the male flushed from a perch tree as a snowmobile passed underneath him. He also flushed in the presence of a snowmobile on 19 April, but was seen holding prey a few meters off the trail only a few moments later. He may not have flown from the snowmobile, but rather, chased a prey animal that had been frightened by the machine.

The same snowmobile came by the nest from the other direction later in the day. The female was perched by the nest and did not flush until people stopped in front of her. She then made a short dive toward the snowmobile, and left the nest site. The hawks appeared to be habituated to moving machines.

A blind was placed on the ground in snow about 30 m from the nest on 1 May 1979. I approached the blind daily and the incubating female did not move except to watch me; she often slept. A tree blind was installed 30 m from the nest on 12-14 June when the chicks were about a week old. The female brooded or stood on the edge of the nest during the blind construction. She did not appear to be disturbed by my approach to the blind, although I often walked within a few meters of her as she perched between the nest and the blind. After mid-June motorcycles, hikers, or riders were seen passing daily beneath the nest. The female never left the nest to attack, even when on one occasion hikers stood under the nest yelling at her.

Additional "disturbance" at this nest included nest tree climbing on four occasions and shooting in the woodlot. The first time the tree was climbed, prior to egg laying, neither parent was nearby. The other three times the female protested vocally and on one occasion the male attacked and joined in cackling.

Shots were heard one day while I was observing the hawks. The female made no response from the nest. The male, perched a few hundred meters south of the nest, did not respond. Shooting was heard by others on at least two separate occasions.

The male at this nest was more aggressive than the female in both years. He flew at me, cackling, two times when I left the woods. In 1980 as I watched the incubating female from a road 31 m from the nest, the male flew at me, struck me in the face, causing me to fall. The behavior of the adults was consistent from 1979 to 1980.

Cooper's Hawk Nest

The Cooper's Hawk nest was 38 m from the road. This area was searched repeatedly

from April until mid-May when I discovered the nest downhill and just out of view from the road. The hawks remained silent if hikers were on the road, but flew from the nest when a person left the trail. The short distance from the trail to the nest should have allowed the hawk to hear passersby. They did not respond, however, unless people were in view.

Discussion and Summary

Inter- and intrasexual variations were noted in the responses of Goshawks to human disturbance. The Mandan female became aggressive after human intrusion at the nest when the young were less than a week old. Her mate vocalized only when someone was in the vicinity of the nest. The site received daily "disturbance" from a variety of sources.

Contrary to the Mandan female, the Meadows female appeared to be very tolerant. Her mate was the more aggressive, yet these birds habituated to high levels of activity. Despite the activity in and around the nest woods each pair hatched and fledged four young in 1979. The Mandan pair fledged four again in 1980, but one of three young from the 1980 Meadows nest was taken by a falconer. Normal fledging in areas of low-medium disturbance in another study in Utah was found by Hennessy (1978) to be 1.2 young on the average with a maximum of 2.0.

Why would Goshawks select a heavily used area for nesting when other undisturbed habitat was nearby? Why did the birds continue nesting as "disturbance" continued and possibly increased throughout the season?

Both Goshawk home ranges were occupied in 1978. Although the hawks were not color marked, evidence suggests that the birds were the same pairs in 1979 and 1980, as indicated by plumage changes and consistency in behavior. In 1978 the Mandan and Cooper's females were in juvenal plumage in these areas. I conclude that in this situation, the 3 pairs of hawks tolerating heavy use of the nesting areas by people were less experienced, young birds. Lack of experience may have led them to choose less favorable sites in which to nest.

A second conclusion is that these nest areas are traditional for Goshawks and Cooper's Hawks. Each had 3 or more nests, indicating that the areas had been used by hawks for many years. The birds may tolerate "disturbance" in order to use an area that meets their resource requirements. The opening up of habitat by ski trails may have increased the usefulness of the area by providing pathways through the woods for hunting (Hennessy 1978). The birds I observed may have hatched in these areas and returned to seek nesting habitat as is often the case for raptors (Newton 1979). Evidence suggests that if the young grow up in an area of high activity, they accept it.

This study illustrates that although we may not believe an area is suitable for nesting accipiters because of human activity, we should not discount it as being suitable for nesting until a thorough search of the area has been conducted. Individual Goshawks and Cooper's Hawks may be more tolerant than we would expect. Wildlife and forest managers should insure that suitable nest trees are provided where the prey base is adequate even in areas of human activity because some of these areas are obviously suitable for nesting.

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NATURAL BREEDING OF *ACCIPITER FASCIATUS* IN CAPTIVITY

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The Brown Goshawk (*Accipiter fasciatus*) is common and widespread in Australia, including Tasmania. It is also found on New Guinea, Timor, Christmas Island and in Indonesia (Brown and Amadon 1968) but does not occur in Fiji as reported by some (e.g., Slater 1970; Condon 1975 and Morris 1976). Very little has been published on its biology and there are no records of successful captive breeding. Our objective in captive breeding was to supplement studies on wild pairs. In addition, the endemic Christmas Island *A.f. natalis* is considered endangered (Curry-Lindahl 1977), and captive breeding may help ensure its survival.

Methods and Results

Both goshawks used in this study had been taken illegally, as nestlings from the wild, and later were confiscated by the National Parks and Wildlife Service in South Australia. They may have been siblings and neither appeared to have been trained nor tamed.

1975

In their second year they were sent to us in Canberra. The male weighed 390 gms, the female 790 gms. Females usually weigh less than 600 gms; Brown and Amadon (1968) give weights of 436 and 593 gms. The female was relatively tame from the outset and the male was extremely timid. They were housed in a large outdoor cage for 6 months before being placed for the breeding season in a 3 m × 10 m × 2½ m solid brick room with no windows and a cement floor, to try to eliminate disturbance. An exhaust fan kept the air fresh and 8 automatically-controlled fluorescent tubes provided light. Lights were regularly adjusted to switch on 0.5 h. before sunrise and off 0.5 h. after sunset, which simulated the natural photoperiod. An oil-filled electric heater kept the temperature of the chamber approximately the same as outdoor temperature.

Nesting platforms, of wooden frames with chicken wire bottoms, were attached to Eucalypt branches in 2 corners of the room. Food was laboratory rats and mice, day old chicks, beef and fresh road-killed birds, given daily in excess of the birds' wants. Water was provided in a shallow round dish. To reduce disturbance, observations were made

through a peephole and lights were turned off when we entered the pen.

Little overt breeding behaviour was observed. The male appeared very nervous in this environment, although not overly fearful of the female. On several occasions she begged him for food and raised her tail, assuming a copulatory position, but was ignored. No nest building was evident. The Australian Kestrel (*Falco cenchroides*) pair in an identical adjoining pen bred successfully.

1976

Two factors from the breeding season seemed worthy of attention:

1. The 1975 housing may have been lacking in necessary visual stimuli. The pair was moved outdoors to a smaller 3 m × 3 m × 2.5 m wire cage completely lined with hessian stapled to the inside of the wire. A bushy wattle tree (*Acacia* sp.) filled about half of the cage and sand covered the floor. This facility received visual (through hessian) and auditory disturbance from men working within 15 m for short periods daily. Wedge-tailed Eagle (*Aquila audax*) and Whistling Kite (*Haliastur sphenurus*) were visible in adjoining pens. Few precautions were taken to minimize disturbance but the cage was entered only once daily, at about the same time (1:00 p.m.), for feeding.

2. The male appeared very timid and unwilling to feed the female in 1975. In February 1976 he was placed in the cage 1 week before the female with the aim of establishing some territorial priority, or advantage through familiarity with the cage. He was removed in April 1976 to be tamed and trained as in Mavrogordato (1973), and then released outdoors daily for 2 weeks to chase House Sparrow (*Passer domesticus*) before being placed back in the breeding pen. He was noticeably tamer and would often come down immediately to obtain food (similar to that given in 1975) when we left the cage.

Both goshawks developed a strong formic acid-type odor (possibly from anting) that is present in most wild Brown Goshawks but was absent when this pair was housed in the solid brick chamber.

On 14 September the female was heard soliciting the male for food, so a nest tray was placed in the tree with the nest of an Australian Magpie (*Gymnorhina tibicen*) secured inside it. They destroyed this nest and built another in its place. A variety of fresh and dried leaves and twigs was supplied; Ribbon Gum (*Eucalyptus viminalis*) was chosen, almost exclusively, by the goshawks for their nest.

On 5 October the female first showed signs of aggression toward us. On 15 October the first of 3 fertile eggs was laid. All were numbered with a felt pen on the day of laying. Unlike falcon or other accipiter eggs we have seen, hers were very thick, completely opaque and impossible to candle. The female began incubating on 21 October. The male was seen incubating on 6 occasions during the 30-day incubation period. Two eggs pipped but 1 young was eaten during or shortly after hatching; the other survived and was cared for by the parents. The third egg contained a dead, full-term embryo. The female continued to attack us until after the chick was removed about 2 months of age.

1977 and 1978

The pair was kept together in the 1976 breeding pen, and bred again in 1977 and 1978. Breeding occurred earlier (Table 1) possibly because the nest was introduced earlier, or because the pair was older or more experienced. In addition, clutch size increased (Table 1) and all eggs hatched. All chicks survived possibly because food was

provided twice daily during the days when eggs were expected to hatch.

In 1978 the young were removed when 24–28 days old, and the pair relayed 18 days later, fledging a second brood in February.

1979

The pair was moved, in late July, to a new room 3 m × 3 m × 3 m made of asbestos sheeting, with sand on the floor. Most of the ceiling and the upper one-third of 1 wall was covered with 5 cm wide slats placed 5 cm apart. Food and water were given through 2 small doors in 1 wall. A nest tray was nailed to a crossbeam in one corner on 24 August. As they had not finished a nest by 14 October, much later than in previous years, a large eucalypt branch was placed in the cage and the nest secured on it. Their first egg was laid 2 days later (Table 1).

Table 1. Clutch sizes and dates when first eggs were laid and tree and nest tray introduced.

Year	Date of first egg	Clutch size	Dates when tree and nest tray introduced
1975	—	—	both always present
1976	15 October	3	tree present, nest tray introduced 12 Sept 1976
1977	28 September	3	tree present, nest tray introduced 9 Aug 1977
1978	a. 29 September	4	tree present, nest tray introduced 27 Aug 1978
	b. 17 December	3	
1979	16 October	4	nest tray introduced 24 Aug 1979. Tree introduced on 14 Oct 1979

Release of Young

Traditional hack (e.g., Mavrogordato 1973) was used for release. Nestlings and nest were placed in a 2-story tower which had previously been modified into a pigeon loft. The loft afforded a good view of surrounding fields. Swinging bars opened inwards only, and could be raised to release the goshawks. After they had fed on the ledge, at the wire barred entrance to the loft for about ten days, the bars were opened. The nestlings were retrapped for measurement approximately once a week during hack by lowering the bars. All young were banded.

Young continued to return for food for 2 weeks to 2 months. They were secretive and, even though in a suburban setting, were seldom noticed. One band was recovered—a male hit by a car in Brisbane, Queensland, 960 km away, 9 months after release.

Discussion

Aggression

Accipiters have generally proven more difficult to breed in captivity than falcons often because females reject or kill males (Berry 1972, Amadon 1975). Reasons why this was not a problem with our pair may include:

1. The extreme dimorphism in this pair; the male was half the size of the female. Some other highly dimorphic accipiters, for example, *A. nisus*, are more often reported to have bred naturally in captivity (e.g., Hurrell 1973; Herren 1970) than less dimorphic species such as *A. gentilis*. Perhaps very small specimens of male *A. gentilis* paired with large females would be more effective. This may decrease the male's vulnerability to injury from the female by making him less threatening or more agile compared to larger males. D. Fleay (pers. comm.) has bred the Grey Goshawk (*A. novaehollandiae*) in captivity. Their size and dimorphism is equivalent to that of our Brown Goshawks (Brown

and Amadon 1968, give the weight of a male Grey Goshawk as 430 g and 2 females 846 g and 990 g). The natural breeding of *A. gentilis* reported by Belcher (1979) was by a 1358 g European female and a 622 g American male. Berry (1970) had considerable difficulty with aggression between an American female (*A. gentilis*) and a European male that was probably larger than an average-sized American male.

2. This type of aggression may not be as common in the Brown Goshawk, or its absence may be an individual characteristic of this female. The fact that she allowed the male to incubate so often suggests considerable tolerance on her part when compared to some accipiters (e.g., Schnell 1958, Kemp and Kemp 1975); however, incubation by the male is frequent in others (e.g., Tarboton 1978).

3. The male was never introduced into a pen where the female had been resident first. Kent (1970) recommended placing the female into the pen before the male, based on his observations of wild goshawks; however, we have seen no evidence in captive breeding research to recommend this practice.

4. We have no evidence that our female was ever imprinted to man, used for hunting or had ever killed anything as is the case with many other goshawks used for captive breeding (e.g., Berry 1972). The male killed prey readily and showed more interest in food.

5. The pair may have been siblings and were raised and kept together.

Breeding Facilities

A comparison of the 2 outdoor and 1 indoor facilities may suggest some requirements for breeding this species. Various stimuli were present in the outdoor cages, e.g., a bushy tree, other vegetation, rain, sunlight, wind, insects (including ants), and the view from the cage. In addition, the provision of dried and fresh leaves and twigs of *E. viminalis* may have facilitated breeding.

Human disturbance may not be as detrimental to the captive breeding of accipiters as we had earlier thought. Though the facilities used may be unsuitable for other accipiters, they were similar to those used successfully by Hurrel (1973) for European Sparrowhawk (*A. nisus*), and David Fleay (pers. comm.) for Grey Goshawks, both of whom found that these species ignored auditory disturbance. Fleay's Goshawks breed annually in his private zoo though subjected to considerable daily disturbance from hundreds of visitors.

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Figure 1. Adult female Brown Goshawk feeding day old chick.

BREEDING THE BLACK SPARROW HAWK *ACCIPITER MELANO-LEUCUS* IN CAPTIVITY

by

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During the spring of 1979, a pair of the African Black Sparrow Hawk (*Accipiter melanoleucus*) bred in my aviaries in Paris. Events from building of the nest to fledging of the young were followed, with a television camera in the aviaries.

Tropical Accipiters have rarely, if ever, been bred in captivity. In the present case, the parent birds were not taken from a nest but were trapped as free-ranging individuals; at least the female had probably had previous breeding experience in the wild. Thus artifacts due to captivity were minimal in the behaviour of this pair. Finally, thanks to the television camera, it was possible, without disturbing the birds, to see in detail sequences of behaviour that are extremely difficult to observe in the field from a blind.

Origin of the birds

The two birds were caught near Makokou, northeastern Gabon (1 lat. N.—12 long). The species is not rare in this area of heavy rain forest, and as elsewhere, is notorious as a poultry-thief. To protect their farmyards, the natives trap these hawks and, during the past 15 years, 14 specimens, dead or alive, were brought to me.

I saw this bird quite often in the field, but always briefly. In Gabon, as in east Africa (Leslie Brown, pers. comm.) the species feeds mainly on pigeons. I observed a male catching a large dove (*Turtur brehmeri*) and another one a pigeon (*Columba unicincta*) as big as itself. A female was seen carrying a large pigeon, and another pursuing a group of green pigeon (*Treron australis*). The pigeons were attacked from high trees, on the border of abandoned cultivations, while feeding on the fruits of low bushes of *Solanum torvum*. In one case, a group of pigeons was attacked above a large river by a female stooping from the sky, like a peregrine. The pursuits I saw were longer, more persistent, and probably faster than those observed in European accipiters.

In the unbroken rain forest of Gabon, the nests of four species of local *Accipiter*—*A. melanoleucus*, *A. tousseneti*, *A. castanilius* and *A. erythropus*—are especially difficult to find, and although nuptial displays were observed on several occasions, in 15 years we found only a single eyrie of *melanoleucus* containing a downy young in November 1979.

History of the parent birds

Among the 14 individuals brought to me, six were alive. They were exported to France, and trained for falconry. One pair was kept in a double aviary, for an attempt at reproduction.

The female was trapped in April 1971. The bird was at least 4 years old, having the breast plain white without black streaks, characteristic of the second and third plumages (pers. obser. on individuals taken in juv. plumage, and kept for more than 3 years in captivity).

After 18 months of captivity, the moult, which was synchronized with the Gabon austral cycle (November–April), became, in Paris, synchronized with the boreal cycle (April–September) and was maintained for 6 years.

From 1971 to 1976, this hawk was used for falconry, catching pheasants, and even, though rarely, attacking mammals. She caught a domestic cat. This bird was shy, of irregular temper and not as efficient as another female of the same origin, that, after a brilliant career in falconry, escaped and became a Wood Pigeon (*Columba palumbus*) catcher on her own from June to December 1970 in the small wood near Paris where she established her territory.

The male was trapped while eating a chicken in February, 1976, when about 3 months old. After 14 months, timing of the moult was synchronized with the boreal cycle. He was not trained for falconry but became rather tame.

Successive attempts at reproduction

During the spring of 1977, the male and the female were put in twin aviaries, separated from each other by a piece of net. Early in June, both birds were carrying twigs, in spite of the fact that the male was far from being adult (he still wore some feathers of the juvenile plumage). As the female was not aggressive toward the male, we removed the net. Good relations were established between the two, which cooperated in building a nest. It was probably too late in the season and no clutch was laid. From this time, they were maintained together continuously.

In March 1978, a new nest was built by both birds, although no other sexual activities—vocal or behavioral—were noticed. The female laid a clutch of 3 eggs (first egg on the 1st, second egg on the 6th, third egg on the 9th of April). After 21 days of incubation, the eggs, all infertile, were removed. The female laid a second clutch of 2 (17th and 20th of May) that were also infertile.

During March 1979, a new nest was built by them at the same place as the preceding one. A television camera was placed in the aviary, and their behaviour noted from 100 m. During March, much time from dawn to sunset was spent in building the nest. Most of the material, branches and twigs, was carried early in the morning. During the day they put the material in proper position, either with the beak or pushing the twigs with the breast against the wall of the nest cup. Finally the cup was furnished with large green leaves of cherry-laurel, cut from the small trees in which the nest was built. The two birds brought material during the entire nesting period, especially green leaves, but also large branches, till the time the young fledged.

A clutch of 4 was laid: sequentially on the 27th of March, 1st of April, 4th of April, and 9th of April. The last three eggs were fertile. The first chick hatched on the 9th of May, the second 13 hours later, the third 5 days later. The third chick, although vigorous, was not fed, was overpowered by its sibs and died when 5 days old. Frequent battles were observed between the two older chicks, which were the same size. Finally, one chick stopped growing when 20 days old, being overpowered by the other. He was ejected from the nest several times by his brother, and on the 6th of June was found dying on the ground with a bruised head. The last young—a male of small size—left the nest when 46 days old. A few days later, he killed chickens, rabbits and young pheasants in the aviary and two weeks later caught free-ranging prey such as large rats, black-birds, magpies, crow, etc.

Behavior of female

The female was first placed in the part of the aviary where a suitable place to build a nest had been prepared. She accepted the place and began to build. After the male joined her, both were seen building at the same rate, and in the same manner.

Before laying, the female spent several days in a "preposital" state. She stood quietly on the nest, the ventral plumage hanging vertically; she took practically no food during this time. Eggs were laid during the afternoon. She stayed on them after the first was laid, continuously during the night and by bouts during the day. The male guarded the nest when the female was absent. After the second egg, incubation became continuous. During the first 10 days the incubating female was very excited, changing position an average of 10 times an hour, rolling the eggs with the beak and perching on the border of the nest to arrange twigs and leaves in the nesting cup. During the last 3 weeks of incubation, the female became more and more lethargic.

The oldest young was fed by the female 13 hours after hatching. The rhythm of feeding during the first two weeks was, on the average, 4 times a day. The male brought prey (sparrows, doves, pigeons, quails) to the edge of the nest and remained perched on it during the time the female plucked the prey and fed the young. An unexpected behavior often occurred: the female fed not only the young but also offered food to the male who, at least during the first week, took much more food for himself from the beak of the female than did the young. Sometimes, the male offered to the young small pieces of meat given to him by the female.

From the preposital to the end of the fledging period, alarm calls were given by both sexes when a potential enemy was in view. During incubation, the female left the eggs when disturbed, but after the young hatched I was savagely attacked by her and quite seriously wounded. Large rats, which were tolerated in the aviary before hatching, were killed systematically (but not eaten). These behaviors ceased completely after the young were removed from the aviary.

The behavior of the female toward the male was especially mild and friendly. Mutual facial greeting was observed. While incubating, the female was seen with the male perched on her back with wings extended in an attempt to shade her. When the female was off the nest, the male always incubated or brooded eggs or chicks. Within a few minutes the female returned and forced the male to leave the nest by pushing him carefully out of the cup with the bend of the closed wing. The only overt aggression between the two birds is described later.

Behavior of male

The behavioral role of the male was more important than expected, especially his role of watcher. He was often the first to give alarm at the approach of a potential enemy (his calls are more rapid, and higher pitched than the female). He took an extreme interest in the events of reproduction. He was seen inspecting for minutes, and touching carefully with his beak the first egg and the newly hatched young. When the female left, the male always came immediately onto the nest. His shading of the incubating female and of the fledglings was constant when the aviary was in sun. The male carried most of the prey to the nest.

During the first stage of the mating period he killed several young wild rats, which were not eaten but placed on the higher perches: offerings to the female?

At the entrance of an intruder in the aviary the male became very excited and on sev-

eral occasions redirected his aggression against his mate: an abnormal behavior, certainly due to captivity. The female was slightly wounded in this manner so I made no more attempts to enter the aviary.

The "deflection of attack" is one of the most significant aspects of human-raptor interaction (Olendorff 1971). Nevertheless, no instance of an irate hawk attacking its mate when a human is close to the nest has been recorded previously.*

Behavior of young

We clearly saw the newly hatched young taking small pieces of food from the beak of the mother (this is not the case in the genus *Falco*, where the newly hatched young begs food in a passerine manner, Brosset 1973).

Our observations of young at the nest were not significantly different from the numerous observations made on young raptors in the wild except for the extreme aggressiveness of the chicks toward each other. Furious battles, with blows on the heads of the siblings, were frequent from the first days after hatching. This resulted in the loss of two of three young. The young had much more food than they could eat and the lack of food had nothing to do with this "cainism."

This behavior is perhaps more developed in the western population of the species than in the eastern population, where L. Brown (pers. comm. and 1980) saw several broods of two and three young in *Accipiter melanoleucus*. By contrast, in 3 cases we saw in Gabon (one brood in the wild, one in captivity, and parents followed by a single young) only one young was fledged. At the same time we saw for several species of birds that the rate of reproduction seems lower in western Africa than in the east (Brosset, in press). Perhaps the case of the Black Sparrow-hawk follows the general rule not through a smaller clutch size, but through more frequent "cainism."

General remarks on this experiment

A single case does not permit generalization and we give here only rough selected data, their interest being that they have been rarely, if ever, recorded in the field.

Sexual maturity

We have no information on the attainment of sexual maturity in females, the only female we tested having been caught as fully adult.

We kept in captivity for more than 3 years 2 males caught as juveniles in Gabon. These two males became sexually adult when three years old. One was observed calling and carrying branches when about 38–40 months old; the other produced young for the first time when 40 months old.

Most species of raptors become sexually mature later in captivity than in the wild. On the other hand, the two males we observed had to resynchronize their moult cycle, which was initially austral, to the boreal cycle.

Perhaps wild individuals are adult earlier, when two years old. This would be easy to verify in the wild, since the second plumage following the first immature plumage is characteristic in the Gabonese population of the species.

We noticed considerable differences in the sexual calling of the two males at the onset of sexual maturity. One was extremely vocal, the other quite completely silent.

Nest building

A first autumnal bout of building took place in November 1978. Much material was brought onto the place of the nest within a week. Then building stopped completely till

*Ed. Note: Female peregrines (*Falco peregrinus*) have been seen to "chase" their mates away from eyries in an "aggressive" manner while investigators are at eyries.

the first days of March 1979 (autumnal carrying of nest material is common in certain palearctic species—such as the House Sparrow (*Passer domesticus*) in Paris).

The rate and technique of building was similar in male and female. We may insist on the important role of green leaves which were brought till the end of the fledging period. This role, subject to some speculation (Olendorff 1971) seems perfectly clear to us. A layer of large green leaves protects the eggs and the young chick against the risk of slipping between the interlacing twigs in the bottom of the cup (L. Brown 1953). This interpretation is not speculative at all. For example, during the first attempt at reproduction, in 1978, when we did not secure green leaves for them, two eggs became entangled in the body of the nest in a position in which the parent birds were unable to incubate or even to recover the eggs. I saw the same phenomenon in the wild. In eastern Morocco, on a "Betoum tree" (*Pistacia atlantica*) I discovered a nest of the Serpent Eagle (*Circus gallicus*) with a non-incubated egg encrusted in the body of the nest. The eagle was setting on a second egg, half incubated, laid in the same nest where the first was lost.

We saw the female several times taking away, from below the young, fouled green leaves, shaking those leaves outside the nest, and replacing the same leaves in the bottom of the nest under the young: sanitary behavior which has perhaps not been observed before in any species.

The clutch

In 1978, the first infertile clutch of 3 eggs was removed after 21 days of incubation. The female laid a second clutch of 2 eggs, also infertile, 20 days later.

In the three clutches laid, the first egg was the most elongated, slightly blotched with pale greenish-brown, the other one being plainly colored of pale grey-green: exactly the color of European Goshawk (*Accipiter gentilis*) eggs. In the third clutch of 4, only the first egg was infertile.

In each clutch, the interval between eggs was 3–5 days. The incubation period was 34 days for the 3 fertile eggs. Two chicks hatched in the afternoon, the other early in the morning.

We saw how egg shells disappeared from the nest. The birds did not take the shells away, as most birds do: the female crushed the shells with her beak and the small broken pieces fell and disappeared between the interlaced sticks of the nest.

The moult

In the 1979 breeding season, the moult began 3 weeks earlier than in preceding years. In both male and female, loss of the first feathers took place during the time the female was laying. Although food was given "ad libitum," the moult stopped completely for both during the entire rearing period, and started again when the fully fledged young were removed from the pen. The moult was completed two months later than the preceding years (an artifact due to captivity?—or a stop related to production of young?).

Feeding behavior

We saw nothing remarkable except during the first two weeks of brooding, the nest was kept perfectly clear of prey remains or non-consumed prey. Between bouts of feeding, prey remains were invariably carried away, usually onto perches and put again on the nest only during feeding time. When the young were able to feed themselves, this

behavior ceased completely and remains of prey, even rotten ones, were spread over the rim of the nest, without being removed by the parents.

This behavior is not special to tropical species of *Accipiter* (Olendorff 1971). In equatorial forest, where predacious animals are abundant, the remains of prey on the eyrie may attract some predators of eggs and young chicks, and the removal by the parents of non-consumed prey from the eyrie may be of survival value for the brood. When the young is capable of self-defense, the adult would cease to keep the nest clean of remains of prey.

Intersexual behavior

Literature concerning behavior of the *Accipiter* in captivity, especially as related to breeding attempts, is full of murder stories, the female killing her "husband." In fact, most of these attempts were made by falconers with eyesses imprinted on Man, birds that do not recognize the nest partner as belonging to their own species. In many birds, the knowledge of a conspecific is not innate but is precociously acquired through the view of the parents. For the imprinted large female hawk, the small male is no more than an item of prey, and is treated as a pigeon or a chicken.

We may believe that the intersexual behavior of individuals taken in the wild as adults or sub-adults would give a better picture of what really occurs under natural conditions. In fact, in this pair of Black Sparrow Hawks, where the male was a "passager" and the female a "haggard" (in falconers' terms) we did not see any fear behavior in the male nor any aggressive behavior in the female.

Conclusion

We are fully convinced of the lesser value of data obtained in captivity, compared with similar data obtained in the field. Nevertheless, where birds are kept in conditions as close as possible to natural, continuous observation in full view with the help of a magnetoscope or a television camera allow one to collect valuable data which would be very difficult to obtain otherwise in the wild from a blind. Comparisons between data obtained in the field and in captivity should permit one to perceive and to understand more fully the sequence of breeding behavior in the raptors.

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Fig. 1. The pair of Gabonese Black Sparrow Hawks at the nest.

ANNOUNCEMENT—MEETINGS COMING UP

International Goshawk Conference

The International Association for Falconry and Conservation of Birds of Prey is organizing a conference on *Understanding the Goshawk* at the Department of Zoology and Wadham College, Oxford, from September 29 to October 1, 1981. The conference will provide a review of recent research findings in sessions on *Systematics and Population Dynamics*, on *Predation and Management*, and on *Falconry and Domestic Breeding*. There will be half-hour papers by main speakers from Britain, Finland, Germany, Holland, Poland, Sweden and the United States and the proceedings will be published.

Booking forms may be obtained by sending a stamped, self-addressed envelope to:

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